Replacing the Aging US 52
Mississippi River Bridge

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Project Overview

• US 52 / IL 64 over the Mississippi River
• Connecting Savanna, IL to Sabula, IA
• Illinois DOT Led Project
• Replacing Existing Cantilever Truss Bridge
  – 520 ft main span
• Extensive Coordination
  – Environmental and Permitting
  – Railroads and Utilities
• Proposed 546 ft Main Span Tied Arch
  – Steel Plate Girder Approaches
  – Drilled Shafts with Coffercell Footings
Project Location

Aerial View

- Sabula, IA
  - "Iowa’s only Island city"
  - Pop. 576
- Savanna, IL
  - “Sportman’s Paradise”
  - Pop. 2,945
Iowa Causeway

National Fish & Wildlife Refuge
The Upper Mississippi River System is the only waterbody in the nation that has been recognized by Congress as a "nationally significant ecosystem and a nationally significant commercial navigation system." (Section 1103 of the Water Resources Development Act of 1986, PL 99-662)

History

- Constructed in 1932
- Savanna-Sabula Bridge Company
- Private Toll Bridge before being turned over to Iowa
- Illinois took over jurisdiction in 1987
- Listed as a Historic Structure in 1999
Existing Bridge

- 947 ft Iowa Approach
- 282 ft Simple Span Truss
- 1,160 ft Cantilever Truss
- 520 ft main span
- 78 ft Illinois Approach
- 2,468 ft in total length
Open Deck Grate

Repairs

- Major repairs in 1985
- Minor repairs in 1999
- Partial replacement of steel grid deck in 2008
  - 28 day road closure and $2.9M
  - Major out cry from public
- Identified more repairs in 2009
  - $8M repairs + $8M user cost
  - 9 month closure, 37 mile detour
- Future repairs?
Key Issues

- **Structurally Deficient**
  - Entire Iowa approach substructure
  - Repairs needed for truss spans
  - Weight Limit

- **Functionally Obsolete**
  - 2 narrow 10 ft lanes
  - Trucks encroach into lane
  - Tight turning radius
  - Steel grid deck

- **Remaining Service Life**
  - 8 to 10 years in current state

Average Daily Traffic (ADT) over the Mississippi

- **Dubuque, IA**
  - US 20: 14,600
  - US 61: 20,700

- **Savanna, IL**
  - US 52: 2,400

- **Fulton, IL & Clinton, IA**
  - IL 136: 10,500
  - US 30: 12,600

- **Quad Cities**
  - I-80: 37,200
  - I-74: 76,700
  - US 67: 30,300
  - I-280: 19,800

- **Vital Transportation Link**
  - Education, Emergency & Jobs
  - Nearest Alternate Crossing
    - Clinton, IA – 20 miles south
    - Dubuque, IA – 45 miles north
Cost & Schedule

Phase I $5 Million
Phase II $5 Million
Phase III $80.6 Million

2010
- Identified for Replacement
- Project Initiation
- Data Collection
- Preliminary Concepts

2011
- Project Initiation
- Data Collection
- Preliminary Concepts
- Cost & Schedule

2012
- Identified for Replacement
- Cost & Schedule

2013
- Identified for Replacement
- Cost & Schedule

2014
- Cost & Schedule
- Preliminary Concepts

2015
- Cost & Schedule
- Preliminary Concepts

2016
- Cost & Schedule
- Preliminary Concepts

2017
- Cost & Schedule
- Preliminary Concepts

2018
- Cost & Schedule
- Preliminary Concepts

US 52 / IL 64 OVER THE MISSISSIPPI RIVER

Coordination & Partners

Coordination

Federal
- Federal Aviation Administration*
- Federal Highways Administration
- US Fish & Wildlife Services
- US Army Corps of Engineers*
- US Coast Guard*
- Tribal Council

State
- IL & IA State Historic Preservation Office
- IL & IA Department of Natural Resources*
- IL & IA Environmental Protection Agency*
- Upper Mississippi Port District*

Local
- City of Savanna
- Savanna Park District
- Property Owners

Private
- BNSF Railway*
- River Industry
- Utilities (Windstream & JoCarroll Electric)
- Engineering & Construction Experts

Partners

Illinois Department of Transportation (Lead Agency)
Iowa Department of Transportation
Federal Highway Administration

Parsons Team
- Parsons Transportation Group – Prime
- Wang Engineering – Geotechnical
- Images – Public Involvement
- Snyder & Associates – Drainage
- Dan Brown & Associates – Foundations
- Michael Baker International – independent check of Tied Arch Design

*Permitting Agencies
**Little Brown Bats**

- Roosting under the bridge and in trees
- USFWS recommended restrictions
- October 1 – March 31

**Shadflies (aka Mayflies)**

- Attracted to light
- Males die after mating
- Females die after laying eggs
- Smell like dead fish
- Short adult life
- Swarms
Bridge for Sale

- Free!
- Half mile long steel truss bridge
- Must be kept “in its historical significance in perpetuity”
- Pay moving cost up to the cost of demolishing it

Scope of Work

- **Phase I**
  - Preliminary Geotech
  - Geometric Design
  - Hydraulic Reports
  - Bridge Condition Report
  - Bridge Type Study
  - Public Involvement
  - Environmental Assessment
  - Project Report
  - TS&L Bridge Plans

- **Phase II**
  - Final Geotech
  - Final Roadway Plans
  - Final Structure Plans
  - Cost & Time Estimates
  - Load Rating
  - Public Communication

- **Phase III**
  - Public Communication
  - Shop Drawing Review
  - Construction Coordination
Constraints

• Iowa Causeway
  – Minimize Environmental Impacts
  – Minimize Causeway Construction

• Illinois Intersection
  – Between bluff and railroad
  – Minimal change to existing IL 84
  – Tie-in at highpoint
  – Limit ROW Impact

• Minimize grades to 4% if possible

Navigation Clearance

• Maintain Existing Clearances
  – Channel near Illinois bank
  – Steep grade with existing tie-in (> 4%)
  – Minimal Superstructure Depth
Navigation Channel Shift

- Approach USCG with Channel Shift
  - Proposed 200 ft shift to west
  - Agreed to 150 ft shift to west
  - Maintain 350 ft channel during construction
  - 7.5 ft superstructure depth and 4% max grade

Bridge Type Study

- Evaluated 3 Types
  - Tied Arch, Cable-stayed, Plate Girder

- Plate Girder abandoned due to structure depth
  - No supports in navigation channel

- Tied Arch
  - Basket-handle, vertical w/ bracing, vertical w/o bracing, single arch
  - Carried forward basket-handle and vertical w/ bracing

- Cable-stayed
  - Evaluated various configurations
  - Carried forward 3 span w/ composite steel girder concrete deck
Bridge Type Study

Criteria
- Initial Cost
- Inspection & Maintenance
- Aesthetics
- Durability
- Constructability
- Environmental Impacts
- Structure Depth
- Geotech
- Hydraulics
- Future Widening

Results
- Tied Arch
  - Float-in Erection
  - Replaceable Deck
- Cable-stayed
  - Not fracture critical
- Similar costs
- Selected Tied Arch
  - Less length of complex structure
  - IDOT familiarity

Bridge Type Study Evaluation
Preliminary Design Development

- Advance Structural Decisions before Final Design
  - Vessel Collision Study
  - Approved Design Criteria
  - Optimized Span Layout / Pier Locations
  - Foundation Type Study

- Tied Arch Concepts Advanced
  - Sections defined and sized (H, I, Box)
  - Floor beam sized and spacing optimized
  - Hanger arrangement and spacing
  - Floating deck concept advanced
  - Stringer fixities defined

- Final Design completed in 12 months to meet schedule
Geotechnical

Proposed Structure

8-span Steel Plate Girder = 1420 ft

546 ft Tied Arch

3-span Steel Plate Girder = 488 ft

508' - 0" CHANNEL

NORMAL POOL

STREAM BED

NORMAL POOL

STREAM BED

Iowa

Illinois
River Pier Foundations

- Minimal cost aesthetic enhancement for arch piers
- Rock close to surface in IL
- 130 ft of sand + on IA side
- Deep river pool
- Waterline footings

Drilled Shaft with Coffercell
Tied Arch

- 546 ft span, 100 ft rise, span to rise ~ 5.5:1
- Floor Beam Spacing – 31'-9"

Cross Section
Floating Floor System

- Replaceable deck with 1 lane of traffic
- Stringers spanning over floor beams
  - Bearings at center span fixed
  - Elastomeric bearings elsewhere
  - Deck full length of span
  - Allows deck replacement half at a time
  - Deck connected to tie at center
- Lower lateral K bracing for wind
  - Braces floor beam at mid-span
- Galvanized floor system
  - Lengths under 60 ft
  - Corrosion protection

Tie Girder and Lower Hanger

- Bolted Box Tie full length
  - Tab plates
  - 6 ft deep
  - HPS50W
- Hanger connection offset from Floor beam
  - Simplifies detailing
- Connection precompressed
- 4 anchor rods provide redundancy
- Shim plates for length adjustment
Arch Rib and Upper Hanger

- **Welded Box Rib**
  - Longitudinal stiffener
  - 5 ft deep
- **Hanger connection offset from bracing connection**
  - Simplifies detailing
- **Two hangers**
  - minimize strand size
  - easier replacement
- **Hanger connections bolted to rib**

Upper Bracing

- **X-bracing chosen**
  - Smaller members than Vierendeel
  - Tension & Compression only
  - More modern look than K-bracing
- **HSS 16x16**
  - Efficient member section
  - Consistent box section
- **Galvanized**
  - Corrosion protection on inside of box
  - Distinct contrast with blue rib
  - Low maintenance / impact to traffic
Redundancy

- **Tie Girder**
  - HPS50W and bolted box provides internal member redundancy
  - Limits propagation of fracture
  - Still Fracture Critical
  - Designed for loss of tie web or flange plate

- **Hangers**
  - Two hangers per location
  - Loss of one hanger with fracture dynamic force (FDF)
  - Loss of both hangers without dynamic force

- **Fracture Load Case**
  - 1.1 DC + 0.75 (LL+IM) + 1.1 FDF
  - LL+IM for 2 striped lanes

Constructability Review

- **Provided IDOT a constructability review**
  - During preliminary design phase

- **Parsons Construction Group**
  - Experience in Large River Bridge Construction
  - Identified staging and access areas
  - Identified potential construction issues

- **Provided IDOT a contractor style estimate**
  - Preliminary and Final Design

- **In house construction estimating team**
3D Printing Model for Public Communication

- In house capability for conveying signature or complex details

On client’s desk!

Drivers’ Perspective Along IL 84
Drivers’ Perspective Approaching Arch

Construction Update

• Sept. 18, 2015 Letting
  – 5 Bids, Low Bid $80.6M to Kraemer, NA

• Construction Started Mid January 2016
  – Clearing & Work Causeway work

• Reviewing Shop Drawings
  – Tied Arch Steel
  – Hangers
  – Bearings

• Reviewing Construction Drawings
  – Coffercell Construction Details
  – Tied Arch Cantilever Erection

• Scheduled Bridge Completion – December 2018
Construction Update – West Abutment & Pier 1

Construction Update – Pier 2
Construction Update – Pier 4

Construction Update – Pier 6
Summary

- Aging Bridge key to local economy
- Extensive Coordination
  - Environmental and Permitting
  - Railroads and Utilities
- Replace with new Steel Tied Arch
  - Improved geometrics
- Keys to Success
  - Strong Community Support
  - Early Client Involvement
  - Preliminary Design Development
  - Constructability Review from Contractor
  - Led to efficient Final Design phase